B801B

MAINTENANCE MANUAL

MP MASTER
MA35878

WAYNE KERR

VHF ADMITTANCE BRIDGE

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INTRODUCTION

This manual contains a technical description of the B801B and gives instructions for the adjustment of the various internal preset controls. Being a passive instrument without power supply, oscillator or detector, a glance at the circuit diagram gives an impression of simplicity. Nevertheless, in the VHF band, small adjustments can have large effects and, in this instrument particularly, some of the operations described require considerable delicacy of touch. Thus it is imperative that any work on the instrument should be undertaken only by operators skilled in VHF techniques. Before commencing any work, the operator should read and thoroughly understand the complete procedure. If any doubt exists, the instrument can be returned to the factory for repair or recalibration.

The bridge operates on the Transformer Ratio-Arm principle, which is fully described in the Wayne Kerr Monograph No. 1, 'The Transformer Ratio-Arm Bridge', a copy of which is available on request.

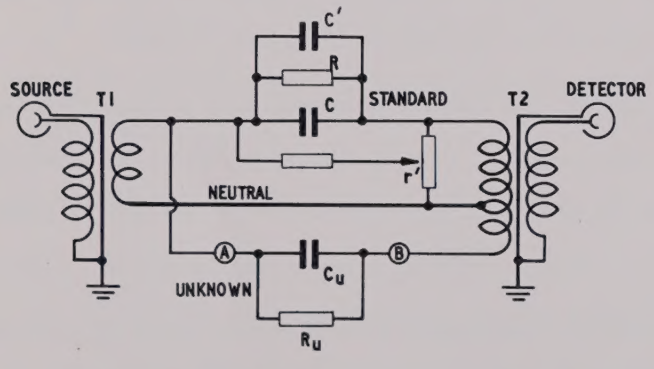
TECHNICAL DESCRIPTION

1 The B801B is a passive instrument used in conjunction with an external oscillator (or source) and detector for the measurement of capacitance and conductance at frequencies between 1MHz and 100MHz.

2 Consider the simplified circuit diagram fig. 1. The source voltage is applied to the bridge through the voltage transformer T1, whose secondary winding drives a current through the standards C, R, and part of the primary winding of the current transformer T2. The same voltage also drives a current through the unknown capacitance and resistance, C_u R_u, and the other part of the primary winding of T2. The secondary winding of T2 is connected to the detector.

3 The two parts of the primary winding of T2 are in opposition, so that if the ampere-turns in each part are equal there will be no flux linked with the secondary winding and the output to the detector will therefore be zero. Under these conditions the detector will indicate that the bridge is balanced.

4 If the two parts of the primary winding of T2 have a known fixed turns ratio, the standard and unknown impedances must have the same ratio if the currents through them are to produce equal and opposite ampere-turns in T2 at balance.



Simplified Circuit Diagram Fig. 1

5 In fig. 1, the voltage applied to the unknown is shown as being the same as that applied to the standard but, in fact, the voltages need not be the same. In this case, the ratio of the unknown admittance to that of the standard admittance is the product of the ratio

of the applied voltages and that of the two parts of the primary winding of T2. In this instrument, the combined ratio thus obtained is 9 : 1.

6 The conductance component of the unknown admittance is balanced by means of the decade resistors (R in fig. 1). The two subsidiary balance controls, C' and r', are used to balance the bridge at any frequency with the main controls set to zero.

7 The capacitance standard comprises the variable capacitor C2 (coarse control) shunted by the fine control capacitor C3 (see fig. 3), both of which are designed to have minimum series inductance. The conductance standards consist of miniature high stability resistors assembled into two decade drums, providing tens and units, and a potentiometer R24 giving fine control between zero and 1mMho.

8 The capacitance between the unknown terminal mounting blocks is padded by the capacitor C6, which is adjusted so that, with the terminals free, the bridge is balanced with the standard capacitors half engaged. This gives a range of positive and negative capacitance values about the balance point.

9 Capacitors C4/C7 and C5/C8 are adjusted to correct the performance of the bridge at each end of its operating frequency band.

10 Before attempting to set up the B801B a knowledge of some aspects of its construction is advisable. These concern the main capacitor C2, the transformers T1 and T2, the conductance standards and the terminal blocks.

11 The voltage transformer T1 comprises an annular core on which is wound the five-turn primary and, diametrically opposite, the three-turn secondary. The secondary winding, with its lead-out connections, is constructed from 1-thou silver tape. The current transformer T2 is similar in construction though the silver tape winding in this case is the primary and it has four turns.

12 The top frame of the standard capacitor C2, the neutral plate and the lower terminal block are arranged one above the other as a

'sandwich' (see fig. 2). The connections between these elements and the two transformers are made by clamping the silver tapes between the appropriate elements, polythene insulation being interposed where necessary.

13 The conductance standards consist of two drums in each of which are mounted nine high stability carbon resistors. The 'tens' drum contains resistors R12 to R20, the 'units' drum contains resistors R2 to R10. The 'resistors' R1 and R11 are dummies, being in fact open-circuit so as to provide a 0 position on each drum and also to preserve the physical layout of the contacts in this position. The drums are so arranged that the end caps of the resistors are exposed and, when in the appropriate position, make contact, via a pair of spring clips, with the extended top plates of capacitor C2.

SETTING-UP INSTRUCTIONS

Test Equipment Required

14 B801B Bridge Standards — Wayne Kerr type Q761

Either Bridge Source S161 (5 - 100MHz) — Wayne Kerr

and Bridge Detector R161 — Wayne Kerr

or Source & Detector type SR268 — Wayne Kerr

Miscellaneous small components are detailed in the text at the appropriate place.

Removal of Case

15 (1) Release the single captive screw at the rear of the instrument. Lift the rear of the top panel and disengage the lip along the front edge of the panel. The terminal assembly is not attached to this panel and remains with the instrument when the top is removed.

(2) Slacken the two outer 6 B. A. Allen grub screws that secure the insulated spindles of both Trim C and Trim R controls. Remove the knobs complete with the insulated spindles.

(3) Remove the four 4 B. A. cheese-head screws from the bottom panel to release the main assembly from the case. Remove the

chassis assembly complete with the front panel. If desired, the Trim C and Trim R knobs can be replaced during the setting-up procedure.

Procedure

16 (1) Connect the source and detector, and set the frequency to 5MHz.

(2) With the Terminal Block TBA1 in place but no other component connected, set the Trim C control (C1) to maximum capacity, the fine C control (C3) to zero and balance the bridge by means of the main C control (C2). This control should then indicate -40pF. If this is not the case, set the dial to indicate -40 and re-balance the bridge by adjusting the preset trimmer C11 (see fig. 4). Seal the trimmer.

(3) Fit the special jig (Q761) to the terminal block TBA1. With all the main controls set to zero, balance the bridge by means of the Trim C and Trim R controls. Fit a resistor of the cracked carbon non-spiralled type into the jig. This resistor should be approximately 20Ω (50mMhos) and its precise value must be determined to better than 1% before trimming commences.

(4) Re-balance the bridge using the three front panel conductance controls. Either the vernier C or the Trim C control can be used to effect the slight C adjustment necessary to achieve precise balance. Note the value of G. Remove the resistor.

(5) Change the frequency of the source signal to 100MHz, reset all front panel controls to zero and balance the bridge by means of the Trim controls.

(6) Replace the resistor in the jig and balance the bridge as described in (4); note this value.

(7) If the G value obtained at 100MHz is greater than that obtained at 5MHz, the spacing between the unknown and neutral tapes (see fig. 2 and 5) must be reduced and vice versa. If the G value at 100MHz is greater than that at 5MHz even when the spacing between the unknown and neutral tapes is reduced to zero, the neutral and standard tapes can be separated. This will have the same effect but at only one-ninth of the sensitivity

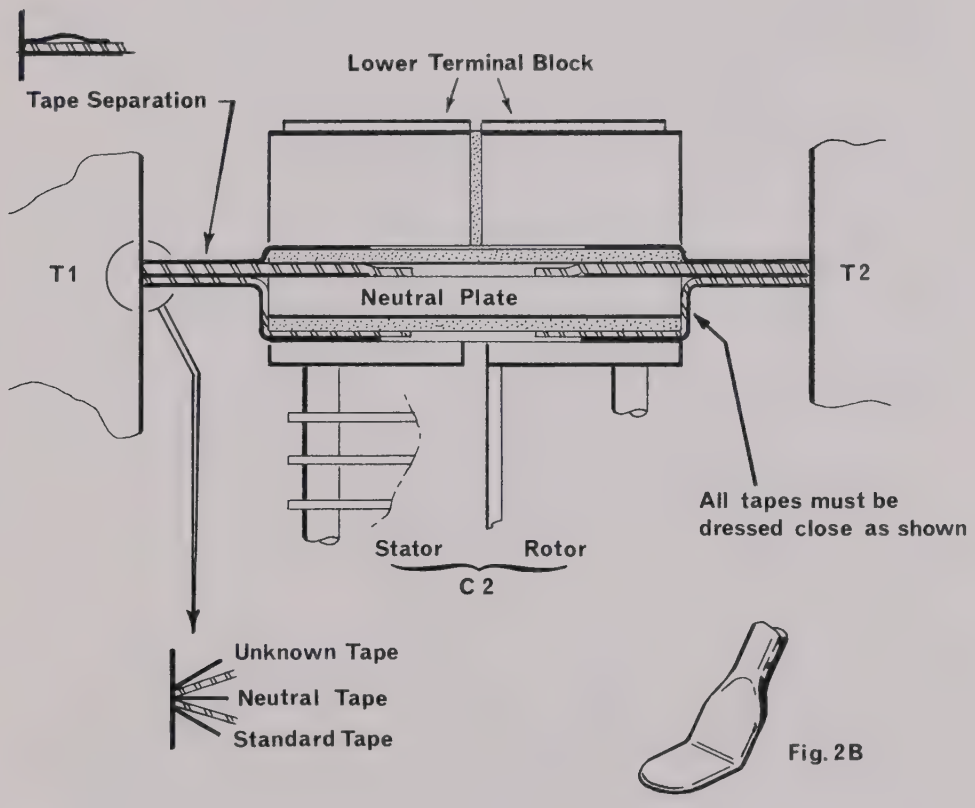


Fig. 2 Section through Transformers and Terminal Block

of movement of the unknown tape. This tape separation can be as large as necessary consistent with final stability. It is important not to resort to this measure until it is certain that no further adjustment of the unknown tape is possible. The tapes should be sealed with a silicone rubber cement (e. g. I. C. I. "Silcoset"); the use of this material is advisable as it permits very small adjustments to be made even after it has set.

NOTE: The necessity for operation (7) is unlikely unless the input (or voltage) transformer T1 has been changed.

CAUTION

The three tapes - unknown, standard and neutral (see fig. 2 and 5) - are formed from 1-thou silver tape, these being separated by 2-thou polythene. If operation (7) is necessary, it must be done with the utmost care to avoid tearing the silver tapes. The operation is best performed using a simple tool shown in fig. 2B. This can be made by hammering flat the end of a length of 16s. w. g. copper wire, which is then shaped as shown, all sharp edges being carefully removed.

(8) If a proper balance cannot be achieved at 100MHz, the A. I. C. resistor R23 (see fig. 3 and 5) should be changed to a lower value. This, in turn, may cause an inability to balance at 5MHz, in which case the A. I. C. resistor R22 should also be changed to a lower value.

(9) Set the source frequency to 5MHz, Millimhos 'tens' drum to 0, 'units' to 1 and vernier (R24) to 0. Balance the bridge by means of the Trim R control. Set the 'units' drum to 0 and re-balance the bridge by means of the vernier control R24; note the vernier indication.

(10) Set the source frequency to 100MHz and repeat operation (9). The final vernier indication should be between 1. 0 and 1. 05. If it is not, change the value of C9 (see fig. 5) until the condition is met. If C9 is not fitted, select a component of value between 3 and 10pF and fit where shown (fig. 3 and 5),

the final value to be determined by trial.

(11) After balancing the bridge at 100MHz with the vernier at 0, check that there is not a second balance point on this control. If there is another balance point, check whether or not C10 is fitted (see fig. 3 and 5); if not, select a component of value between 5 and 15pF and fit where shown, the final value to be determined by trial. If C10 is fitted, its value may require changing.

(12) Fit the instrument into its case but do not, at this stage, fit the top panel. Fit the L-shaped grounding strip between the ground terminal and the terminal block screw remote from the Neutral terminal block.

(13) Select two high stability 1/4W carbon resistors of value approximately 50Ω each; they should be equal in value to within 1% but not necessarily to 50Ω. The resistors should be connected in series between the unknown terminals in such a manner that the centre-tap, by a slight depression, can be touched on to the left-hand ground screw (viewed from the front).

(14) Set the source frequency to 25MHz, the Millimhos drums to 0 and 9, and the vernier Millimhos to 0.4. With the resistor centre-tap (operation 13) unconnected, balance the bridge by means of the Trim C and Trim R controls.

(15) Touch the resistor centre-tap to the ground terminal and re-balance the bridge by means of the vernier C and vernier Millimhos controls. Note the change in the vernier Millimhos indication. If the new indication is less than 0.4, reduce the capacity of trimmer C5 and vice versa. The final setting of C5 should be such that the vernier Millimhos dial indicates between 0.4 and 0.45 whether the resistor centre-tap is grounded or not.

(16) Fit the top panel, set the source frequency to 100MHz and, using the above procedure, check that the vernier Millimhos indication when the resistor centre-tap is grounded and when free does not differ by more than 0.2mMho. If it does, adjust

C4 (see fig. 5) until the grounded indication is within 0.2mMho of the free indication. If this adjustment is made, operations (14), (15) and (16) must be repeated since trimmers C4 and C5 interact to some extent.

(17) Set the source frequency to 5MHz. Connect the 100pF Standard Capacitor Q761 to the bridge, without the ground plate but ensuring that the capacitor is firmly seated on the terminals. Set the C vernier to 0, and balance the bridge by means of the main C control; note the dial indication. Without disturbing the Standard Capacitor, change the frequency to 100MHz. Re-balance the bridge by means of the main C and Trim R controls; note the main C dial indication. Remove the capacitor and re-balance on main C and Trim R, again note the main C dial indication. The algebraic sum of the two 100MHz indications should be within ±2% of the 5MHz indication. If this is not the case, a very small adjustment to the tapes (see operation 7) can be made to achieve the required result (the plasticity of the compound used previously will allow this).

(18) Connect to the bridge a 20mMho (50Ω) resistor whose value is accurately known. Measure this at 100MHz with the ground plate in place, and again at 60MHz without the ground plate. Adjust the tapes as above until both the values thus obtained are within 2% of the known value.

NOTE: To satisfy the requirements of operations (17) and (18), it may be necessary to set one condition near the tolerance limit so as to bring the other condition within specification.

(19) To check the Millimhos drum resistors, remove the two 8 B.A. round-head screws that secure the plastic cover (see fig. 4B); remove the cover to free the resistors. It is advisable to withdraw, measure and replace each one before withdrawing the next to avoid incorrect reassembly. The values should be as tabulated below to within +0.5, -1.0%.

COMPONENTS LIST

When ordering spare parts, please quote the Instrument Type and Serial Numbers, and the circuit reference and value of the required component.

R1	Dummy	+0.5, -1%	1/8W	Welwyn Type 7C21 or Dubilier Type S130 to W. K. Drawing D11665
R2	9000			
R3	4500			
R4	3000			
R5	2250			
R6	1800			
R7	1500			
R8	1286			
R9	1125			
R10	1000			
R11	Dummy			
R12	900			
R13	450			
R14	300			
R15	225			
R16	180			
R17	150			
R18	128.6			
R19	112.5			
R20	100			
R21	500 variable	20%	1/4W	Plessey CP404/1/01011/002
R22	A. I. C.	20%	1/4W	Morgan Type S or T
R23	A. I. C.	20%	1/4W	" " "
R24	500 variable	20%	1/4W	Plessey CP404/1/01011/002
R25	5000	5%	1/8W	Welwyn Type UA or SUA 3611

C1	16p	variable	W. K. D10005
C2	60p	"	W. K. D8120
C3	4p	"	W. K. D8123
C4	12p	"	Wingrove & Rogers Type C3201
C5	12p	"	" " " "
C6	A. I. C.		Erie 'Ceramicon' N750A
C7	A. I. C.		
C8	A. I. C.		
C9	A. I. C.		
C10	A. I. C.		
C11	1.5p	variable	Cambion Type CSM150

T1	Input Transformer	W. K. D8128
T2	Output Transformer	W. K. D8129

POSITION	UNITS DRUM	TENS DRUM
0	Dummy	Dummy
1	9.0k	900Ω
2	4.5k	450Ω
3	3.0k	300Ω
4	2.25k	225Ω
5	1.8k	180Ω
6	1.5k	150Ω
7	1.28k	128.6Ω
8	1.12k	112.5Ω
9	1.0k	100Ω

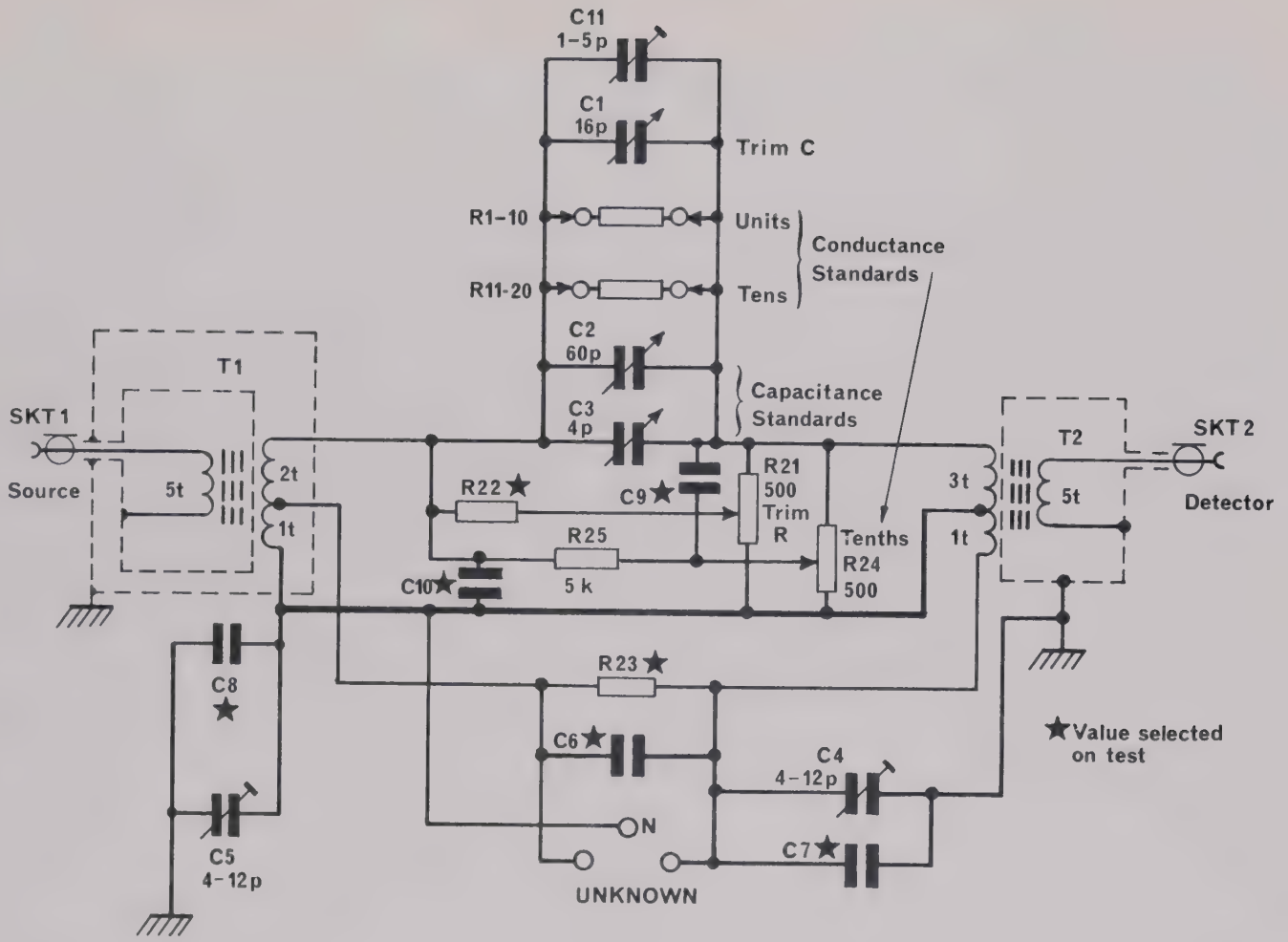
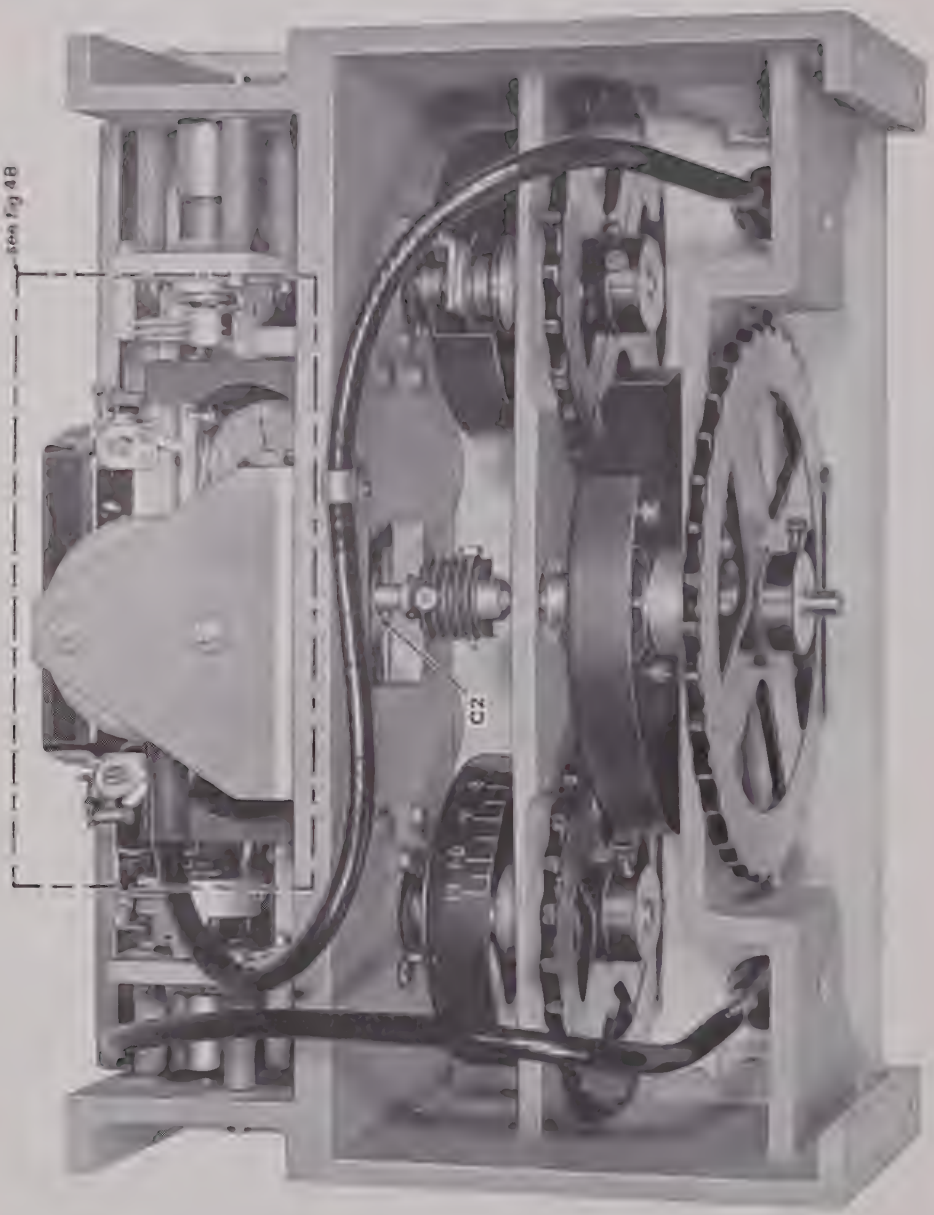


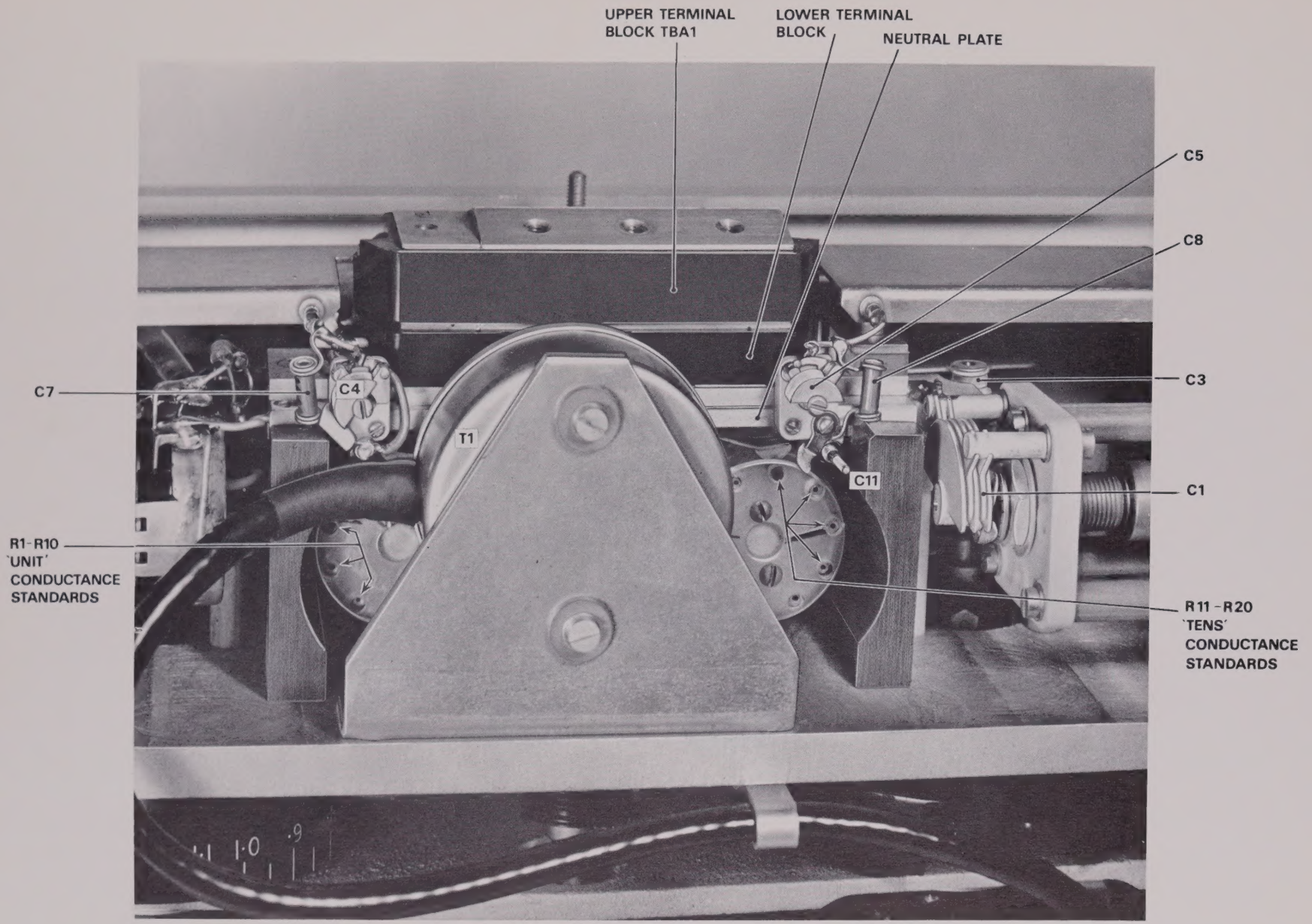
Fig. 3 VHF Admittance Bridge B801B — Circuit

WK Drg. No. D11076/B



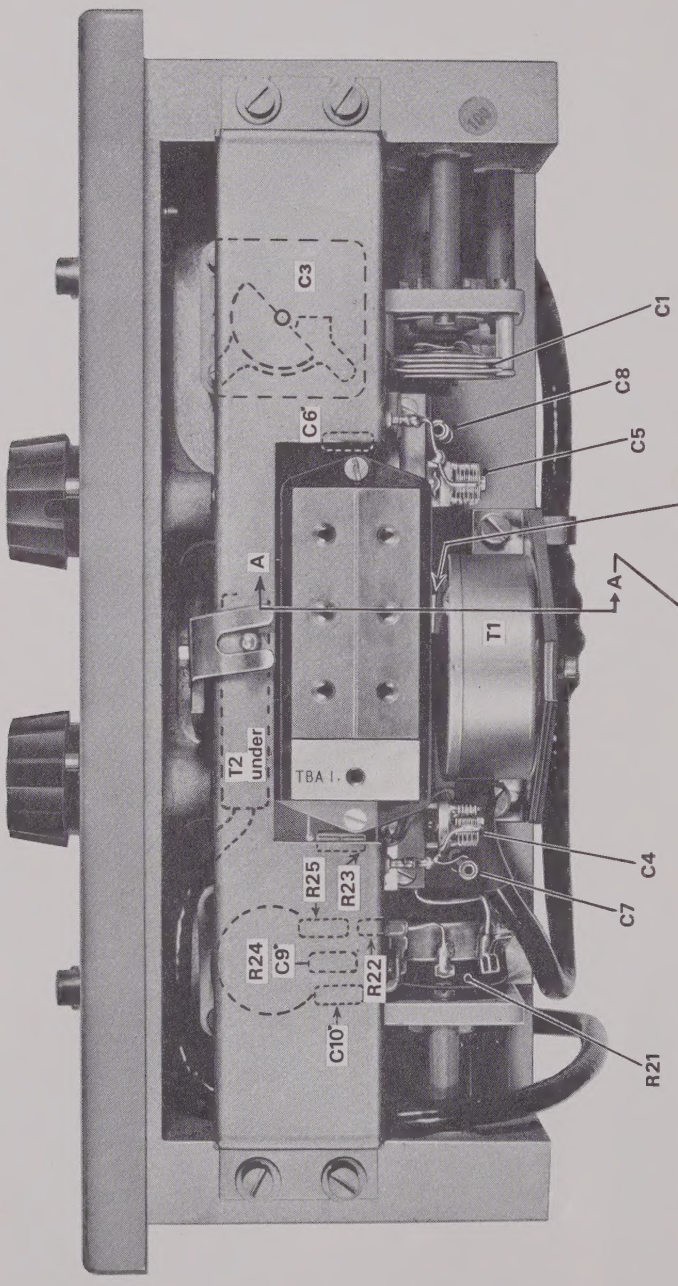
REAR VIEW WITH CASE REMOVED

FIG. 4A



ENLARGED VIEW OF AREA INDICATED IN FIG.4A

FIG. 4B



TOP VIEW WITH CASE REMOVED

FIG. 5

MP MASTER
MA35878

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